Tanta University	Department: Electronics and electrical communication Dept	Faculty of Engineering
Programme: Final Exam
Total Marks: (75) Marks

Course Title: Electronic Measurements (2)	Course Code: EEC 2209	Year: second year
Date: 1-6-2016	Allowed time: 3 hours	No. of Pages: (3)

Remarks: (answer the following questions ... assume any missing data ... arrange your answer booklet

Use graphs and examples whenever you have a chance during your answer

Question No. 1 : (15) Marks

A. Using proof, show how you can obtain Z-parameter from h-parameter? (5) Marks

B. Obtain h- parameter of the two-port network shown in Fig.1. (5) Marks

C. Find Y-parameter of this circuit shown in Fig.2. (5) Marks

Question No. 2 : (15) Marks

A. Explain the basic principles of sinusoidal oscillators? (5) Mark

B. For the circuit shown in Fig.3, sketch and label the transfer Ch/s vo-vi. The diodes assumed to have a constant 0.7 V drop when conducting and OP-AMP saturated at ±12V. (5) Marks

C. Consider the circuit shown in the Fig.4, with Rf removed to realize the comparator function. Find the suitable values for all resistors so that the comparator output levels are ±6V and the slope of the limiting Ch/s is 0.1. Use power supply ±10V and assume the voltage drop of a conducting diode to be 0.7V. (5) Marks

Question No. 3 : (15) Marks

A. Prove that the resonance frequency of the Wien bridge feedback section is

$f_o = \frac{1}{2\pi RC}$ and the gain equal to $\frac{1}{3}$. (5) Marks

B. Explain the operation of the Bi-stable multivibrator? Show how you can draw the transfer function of Bi-stable multivibrator? (5) Marks

C. Show how to generate a Square waveform using A stable multivibrator? (5) Marks

Use only black or blue pens or pencil in your answer

Do not make any mark in your booklet

Answer only the required questions (Extra answers will not be considered)

Question No. 4 : (15) Marks

A. Using the Fig.5, design a circuit that provides square wave of 10V peak to peak and triangular wave of 10 V peak to peak. The frequency is to be 1KHz. Use 0.01μF capacitor. Implement the bistable circuit with the circuit shown in Fig.6. And specify the values of all resistors and the required Zener voltage. Design for a minimum zener current in the resistor divider of 0.2VmA. Assume that the output saturation levels of the op amp are voltage ±13V. (5 marks)

B. Explain the operation of 555 timer as A stable multiviberator? (5 marks)

C. Using a 680 Pf capacitor, design the 555-timer astable circuit to obtain a square wave with a 50 KHz frequency and 75% duty cycle. Specify the values of the resistor used. (5 marks)

Question No. 5 : (15) Marks

A. Explain the pulse Echo system to measure the ultrasonic waveform? (5 marks)
B. Explain the ultrasonic waves advantages? (5 marks)
C. Explain the operation of 555 timer as mono-stable multiviberator? (5 marks)

The end of questions
Good luck
Dr / Hossam Kasem (Coordinator of the Course)

Use only black or blue pens or pencil in your answer
Do not make any mark in your booklet
Answer only the required questions (Extra answers will not be considered)

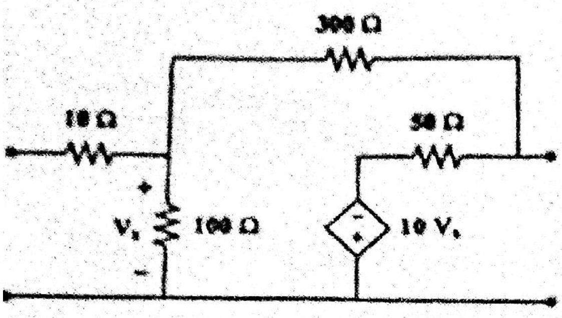


Fig.1

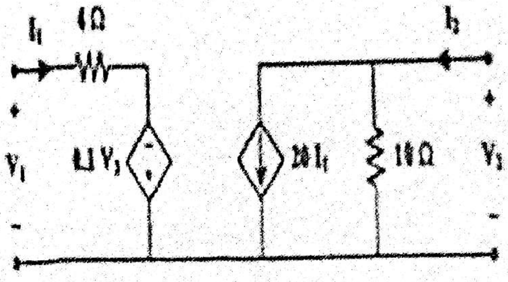


Fig.2

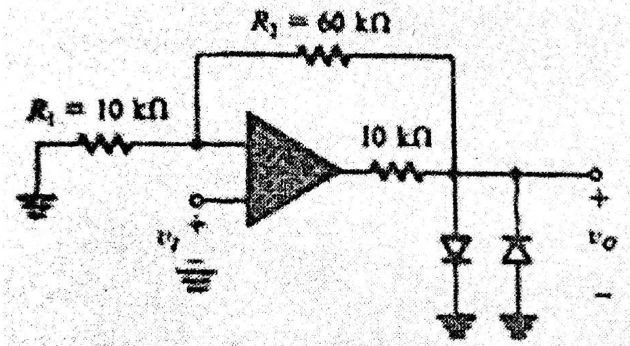


Fig.3

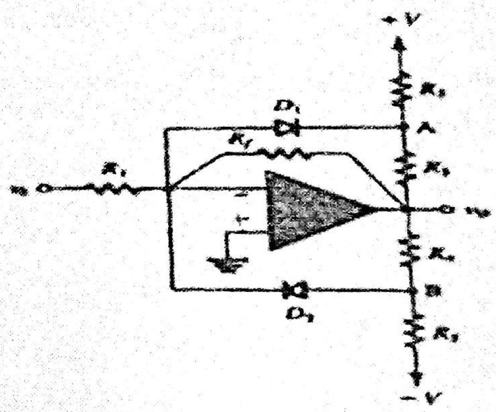


Fig.4

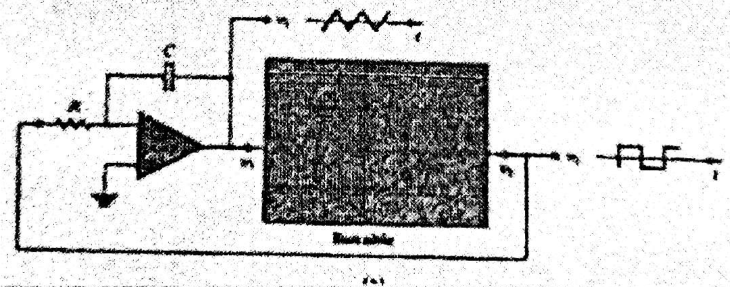


Fig.5

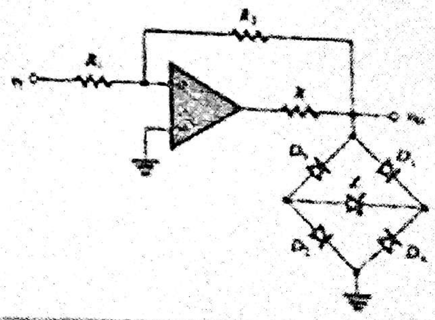


Fig.6

Use only black or blue pens or pencil in your answer

Do not make any mark in your booklet

Answer only the required questions (Extra answers will not be considered)

Final exam

Electronic measurement (II)

Question No (1)

A- prove Z-prameter from h parameter

$$* \quad V_1 = h_{11} I_1 + h_{12} V_2$$
$$** \quad I_2 = h_{21} I_1 + h_{22} V_2$$

$$V_1 = Z_{11} I_1 + Z_{12} I_2$$
$$V_2 = Z_{21} I_1 + Z_{22} I_2$$

$$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0}$$

From * & ** put $I_2 = 0$

$$0 = h_{21} I_1 + h_{22} V_2$$
$$V_2 = \frac{-h_{21} I_1}{h_{22}}$$
$$V_1 = h_{11} I_1 + h_{12}\left(\frac{-h_{21}}{h_{22}} I_1\right)$$
$$\frac{V_1}{I_1} = h_{11} - \frac{h_{12} h_{21}}{h_{22}}$$
$$\frac{V_1}{I_1} = \frac{h_{11}h_{22} - h_{12}h_{21}}{h_{22}} = \frac{\Delta h}{h_{22}}$$

$$\therefore Z_{11} = \frac{\Delta h}{h_{22}}$$

where $\Delta h = h_{11} h_{22} - h_{12} h_{21}$

$$\rightarrow Z_{12} = \frac{V_1}{I_2}\Big|_{I_1=0}$$

From * & ** put $I_1 = 0$

$$\therefore V_1 = h_{12} V_2 \rightarrow (1)$$
$$I_2 = h_{22} V_2 \rightarrow (2)$$

(1) / (2)

$$\frac{V_1}{I_2} = \frac{h_{12}}{h_{22}}$$

$$\therefore Z_{12} = \frac{h_{12}}{h_{22}}$$

$$\rightarrow Z_{21} = \frac{V_2}{I_1}\Big|_{at\ I_2=0}$$

From * & ** put $I_2 = 0$

$$0 = h_{21} I_1 + h_{22} V_2$$
$$\frac{V_2}{I_1} = \frac{-h_{21}}{h_{22}}$$

$$\therefore Z_{21} = \frac{-h_{21}}{h_{22}}$$

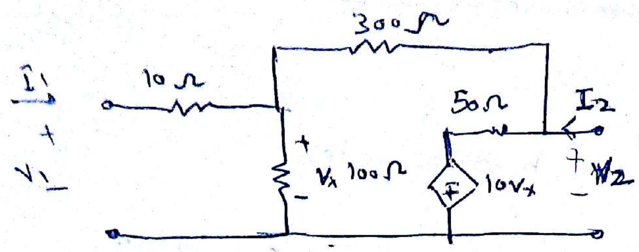
$$\rightarrow Z_{22} = \frac{V_2}{I_2}\Big|_{I_1=0}$$

From * & ** put $I_1 = 0$

$$V_1 = h_{12} V_2$$
$$I_2 = h_{22} V_2$$
$$\therefore \frac{V_2}{I_2} = \frac{1}{h_{22}}$$

$$\therefore Z_{22} = \frac{1}{h_{22}}$$

B- Obtain h-parameter From Fig 1.



$V_1 = h_{11} I_1 + h_{12} V_2$

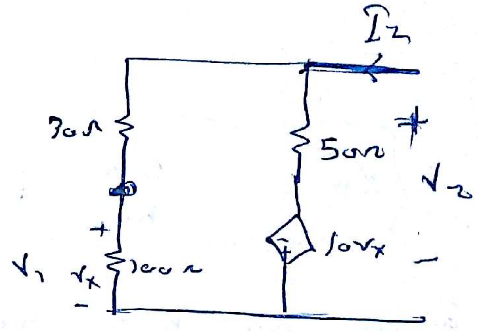
$I_2 = h_{21} I_1 + h_{22} V_2$

$h_{11} = \frac{V_1}{I_1}\Big|_{V_2=0}$

at V_2 short circuit

$h_{11} = 10 + (300 \,//\, 100) = 85\,\Omega$

$h_{12} = \frac{V_1}{V_2}\Big|_{I_1=0}$

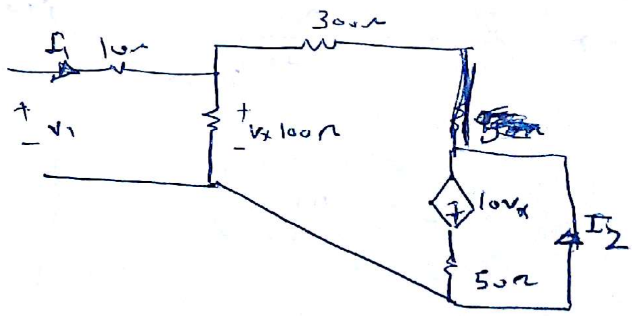


voltage divider

$V_1 = V_2 \frac{100}{100+300} \longrightarrow \frac{V_1}{V_2} = \frac{1}{4}$

∴ $h_{12} = \frac{1}{4}$

$h_{21} = \frac{I_2}{I_1}\Big|_{V_2=0}$



$I_2 = I_x - \frac{100}{300+100} I_1$

$I_{100\Omega} = \frac{300 * I_1}{100+300} = \frac{3}{4} I_1$

$V_x = 100 * \frac{3}{4} I_1 = 75 I_1$

∴ $I_2 = \frac{10(75 I_1)}{50} - \frac{I_1}{4} = 15 - \frac{I_1}{4} = 14.75 I_1$

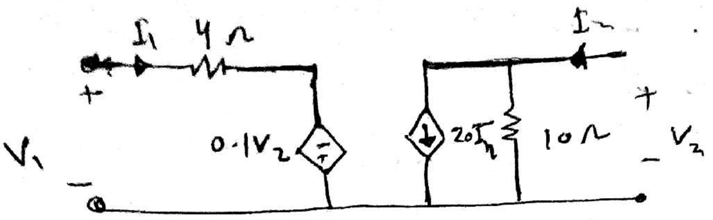
∴ $h_{21} = \frac{I_2}{I_1} = 14.75$

$h_{22} = \frac{I_2}{V_2}\Big|_{I_1=0}$

$I_2 = \frac{V_2 + 10V_x}{50} + \frac{V_2}{300+100}$ | $V_x = \frac{V_2}{400} * 100 = \frac{V_2}{4}$

$h_{22} = \frac{I_2}{V_2} = \frac{1+\frac{10}{4}}{50} + \frac{1}{400} = 0.0725\ \Omega^{-1}$

C- Find Y - parameter of two-port network from Fig 2. [3]



K.V.L

$V_1 = 4 I_1 + 0.1 V_2$ ⟹ $I_1 = \frac{1}{4} V_1 - \frac{0.1}{4} V_2$ → *

K.C.L

$I_2 = 20 I_1 + \frac{V_2}{10}$

$I_2 = 20\left[\frac{V_1}{4} - \frac{0.1 V_2}{4}\right] + \frac{V_2}{10} = 5V_1 - \frac{1}{2} V_2 + \frac{V_2}{10}$

$I_2 = 5 V_1 - \frac{2}{5} V_2$ → **

$I_1 = Y_{11} V_1 + Y_{12} V_2$

$I_2 = Y_{21} V_1 + Y_{22} V_2$

$Y_{11} = \frac{1}{4}$ $Y_{12} = -0.025$

$Y_{21} = 5$ $Y_{22} = -0.4$

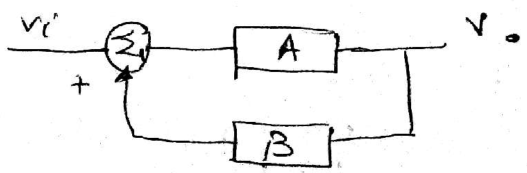
Question No. 2:

A- An electronic device generate Ac signal without input Ac by noise or DC can be generate but with condition

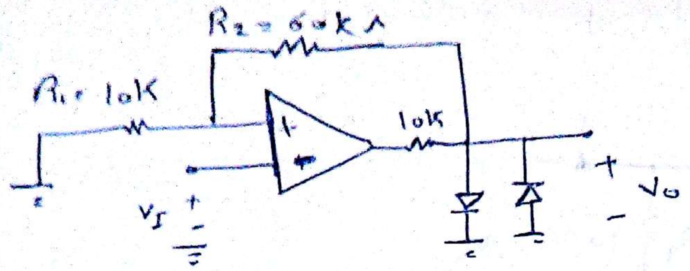
$AB > 1$ start oscillation

$AB = 1$ to sustain oscillation

$A_f = \frac{A}{1 - AB}$



B)



$V_D = 0.7$ volt

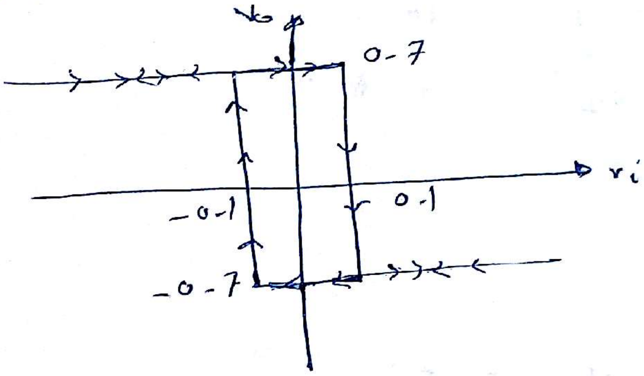
Inverting Bistable

$L_+ = 0.7$ volt

$L_- = -0.7$ volt

$V_{th} = \beta L_+ = \frac{R_1}{R_1+R_2} * 0.7 = 0.1$ volt

$V_{TL} = \beta L_- = -0.1$ volt

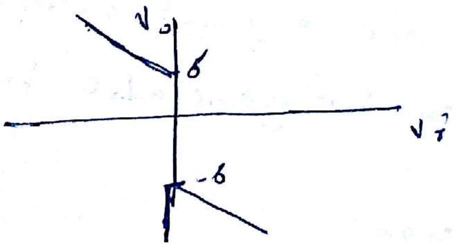


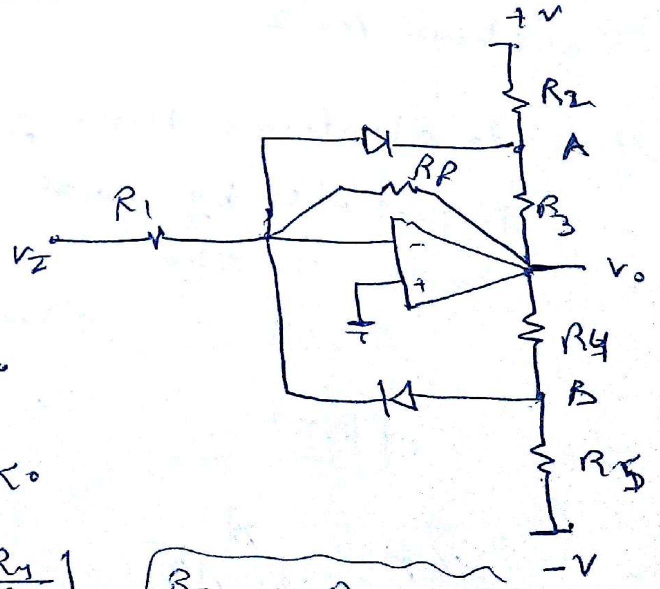
Transfer Function.

c) Find suitabe values for all resistors

$V_o = \pm 6$ volt Slope limiting = 0.1

$V_{CC} = \pm 10$ volt $V_D = 0.7$ volt





Slope $\left[\begin{array}{ll} -\frac{R_3}{R_1} & v_i > 0 \\ -\frac{R_4}{R_1} & v_i < 0 \end{array} \right.$

After remove Rf

$L_+ = V\left(\frac{R_4}{R_5}\right) + 0.7\left(1 + \frac{R_4}{R_5}\right)$ $\boxed{\frac{R_3}{R_1} = \frac{R_4}{R_1} = 0.1}$

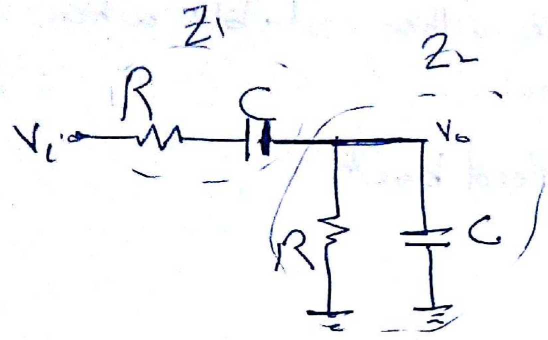
$V = 10$ volt $L_+ = 6$ volt

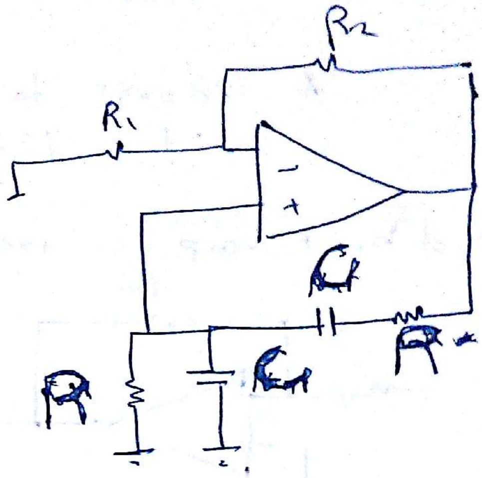
$\frac{R_3}{R_2} = \frac{R_4}{R_5} = 0.4953$.

$R_5 = R_2 = \frac{0.1}{0.4953} R_1$

Question No. 3 (5)

A- prove wein bridge feed back





$X_c = \frac{1}{\omega C}$

$Z_1 = R - J X_c$

$Z_2 = \frac{-R X_c J}{R - J X_c}$

$\frac{V_o}{V_i} = \frac{Z_2}{Z_1 + Z_2} = \frac{-J R X_c}{(R - J X_c)^2 - J R X_c \frac{(R - JX_c)}{(R - JX_c)}} \times \frac{J}{+J}$

$\frac{V_o}{V_i} = \frac{R X_c}{R X_c + J (R^2 - 2 R X_c J - X_c^2)}$

$\frac{V_o}{V_i} = \frac{R X_c}{R X_c + 2 R X_c + J (R^2 - X_c^2)} = \frac{R X_c}{3 R X_c + J (R^2 - X_c^2)}$

at resonance Real $\Rightarrow$ imaginary $= 0$

$R^2 - X_c^2 = 0$ $R = X_c$

$R = \frac{1}{2 \pi f C}$ $\Longrightarrow$ $f_r = \frac{1}{2 \pi R C}$

at f_r $\frac{V_o}{V_i} = \frac{R X_c}{3 R X_c} = \frac{1}{3}$

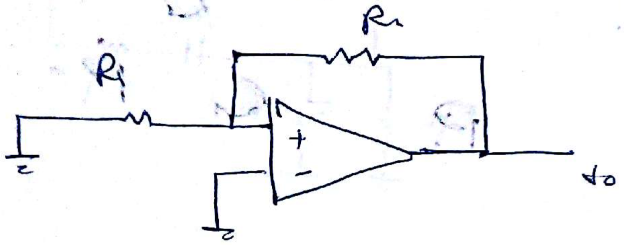
(B)

Bistable multivibrator

* Can be at one of two possible State idefinitly.

* moves to the other stable when it's trigger.

* Feedback Loop +ve feed back



$V_o = A(v^+ - v^-) = Av^+$

$V_+ = \beta V_o$ hence, $\beta = \frac{R_1}{R_1 + R_2}$

* consider i/p is noise signal → very Low amplitude

* Noise is amplified

* Fraction of output is feedback to the input terminal thus increasing the out put signal

* $V_o = L_+$ ⟶ +ve saturation level → often vcc

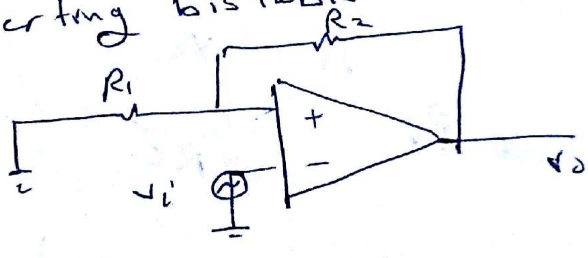
* when noise is -ve value $V_o = Av_+$

vo decrease to go to negative

V_+ ⟶ $-ve$

Vo continous to decrease until $v_o = L_-$ negative saturation

* Interting bistable



[1] Let $v_o = L_+$

$v^+ = \beta v_o$ $V_o = A(v^+ - v^-) = A(\beta L_+ - v_i)$

$v_o = L_+$ vi increase untile $v_i = \beta L_+$

Vo ⟶ +ve

& exceed

$v_i = V_{TH}$

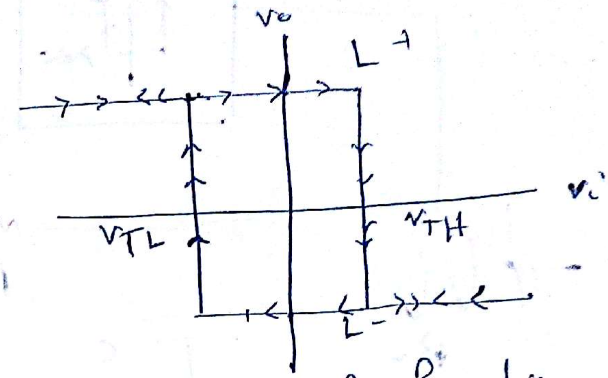
[2] $v_o = L_-$ $v_o = A(AL_- - v_i)$

$v_o \longrightarrow -ve$ (small values of v_i)

v_i decrease until $v_i = BL$ & goes beyond $v_i = V_{TL}$

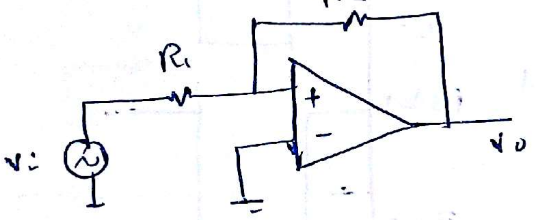
$V_o = A(BL - v_i)$

$V_o = L+$



Transfer function

Non-inverting bistable



$$V_+ = \beta v_o + \frac{R_2}{R_1 + R_2} v_i$$

$$V_o = A(v^+ - v^-) = Av^+$$

① Let $V_o = L^+$

if $v_i = +ve$ value No effect on the out put

⟹ if v_i decrease until V_+ = zero where $v_i \longrightarrow -ve$

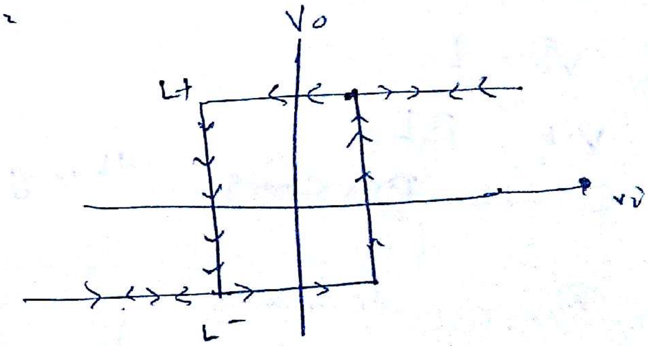
At this point $v_i = V_{TL}$

$$0 = L_+ \frac{R_1}{R_1 + R_2} + V_{TL} \frac{R_2}{R_1 + R_2}$$

$$V_{TL} = -L_+ \frac{R_1}{R_2}$$

② $V_o = L-$

$$V_+ = L- \frac{R_1}{R_1 + R_2} + v_i \frac{R_2}{R_1 + R_2}$$

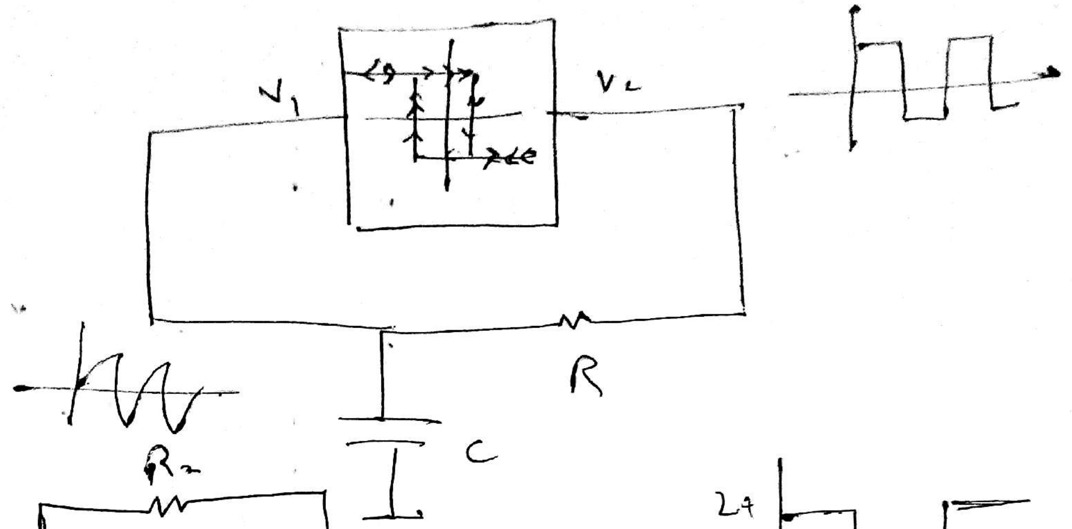


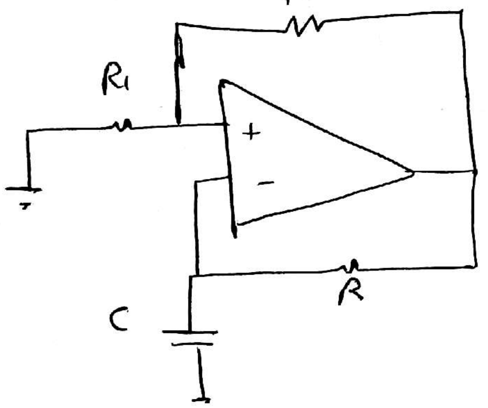
→ v_i −ve No effect

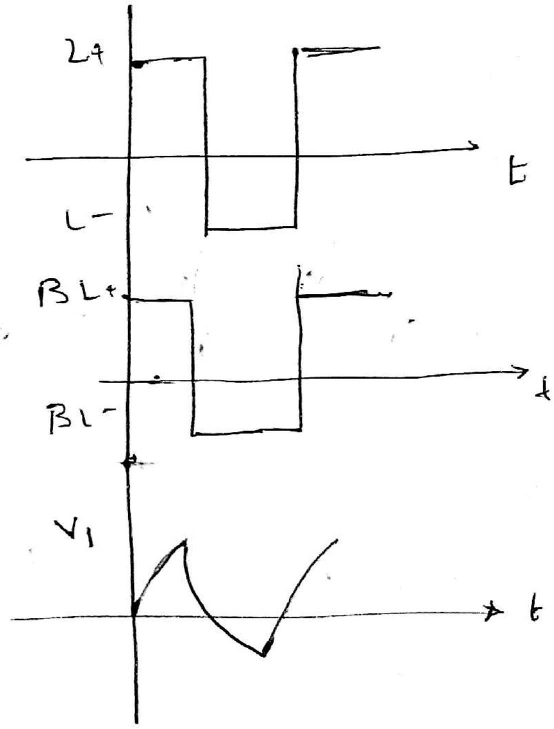
− v_i +ve increase to $V_+ = 0$

at this point $v_i = V_{TH}$ and $v_o = L^+$

c) Astable Multivibrator.







$\tau = RC$ $\qquad$ $V_o = L_+$

$v_+ = \beta L_+$ $\qquad$ C → charge

towards $- v_o (L_+)$

$v_- \uparrow \longrightarrow \beta L_+$

$v_o = A(\beta L_+ - v_-)$

$V_o = -ve$

$v_o = L_-$

② $V_o = L_-$

$V_+ = \beta L_-$

C → Discharge through R with time constant

$V_- \longrightarrow$ decrease

$v_o = A(\beta L_- - v_-)$

When $v_- = \beta L_-$ & go beyond

$v_o = L_+$ $\qquad$ C charges again

Periodic

$T = T_1 + T_2$

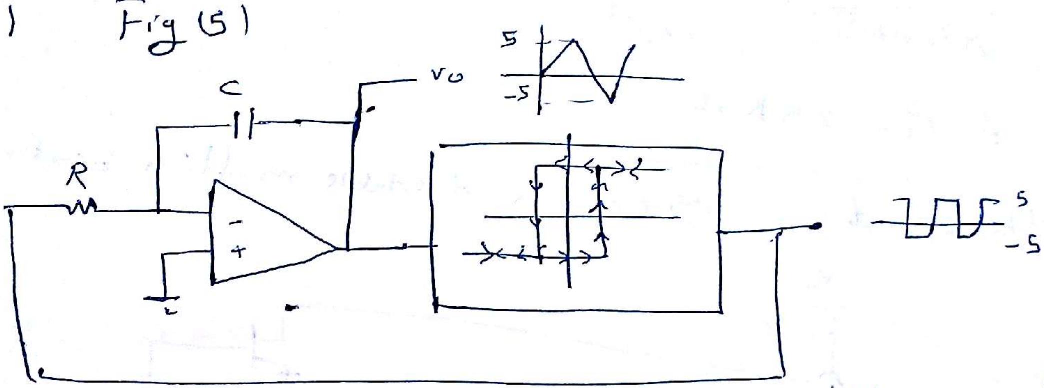
$T_1 = \tau \, Ln\left[\frac{1-\beta\left(\frac{L-}{L+}\right)}{1-\beta}\right]$

$T_2 = \tau \, Ln\left[\frac{1-\beta\left(\frac{L+}{L-}\right)}{1-\beta}\right]$

$L_+ = -L_- \longrightarrow T = 2\tau \, Ln\left[\frac{1+\beta}{1-\beta}\right]$

Question (4)

A) Fig (5)



$V_{TH} = -L_+ \frac{R_1}{R_2}$

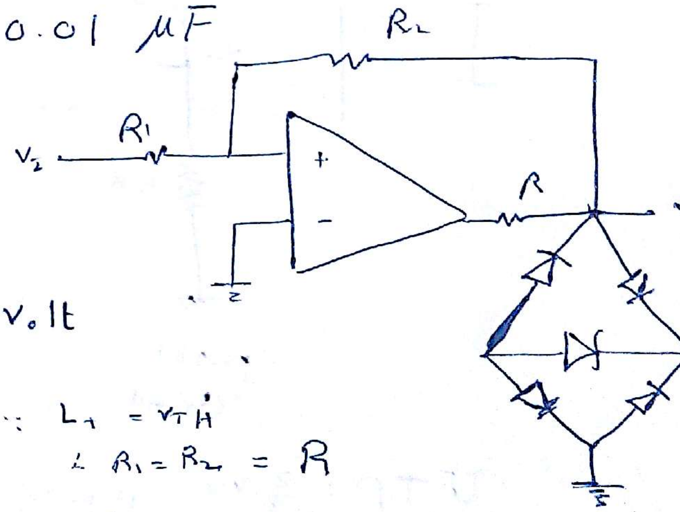
$V_{TL} = -L_- \frac{R_1}{R_2}$

$V_{cc} = \pm 13$ volt

$L_+ = 5$ volt

$V_{p.p}$ triangle $= 10$ volt

$f_r = 1$ KHZ , $C = 0.01\ \mu F$



$V_o = \pm 5$ volt

$V_D = 0.7$ volt

$V_o = 2V_D + V_Z$

$5 = 1.4 + V_Z \Longrightarrow V_Z = 3.6$ Volt

$L_+ = -L_- = 5$ volt $\quad \because L_+ = V_{TH}$

$V_{TH} = -V_{TL} = -5$ volt $\quad \therefore R_1 = R_2 = R$

Max current in feedback $= 0.2$ mA

$10^{-3} * 0.2 = \frac{5}{R_1 + R_2} = \frac{5}{2R}$

$R_1 = R_2 = R = \frac{5}{0.2 * 2 * 10^{-3}} = 12.5\ K\Omega$

Max diode Current = 1 mA

$$\frac{13-5}{R_2} = (0.2+1)\ mA$$

$$\therefore R_Z = \frac{8}{1.2\ mA} = 6.67\ K\Omega$$

From Fig 5

Slope $\frac{-1-}{RC} = \frac{V_{TH}-V_{TL}}{T/2}$

$f = 1KHZ$

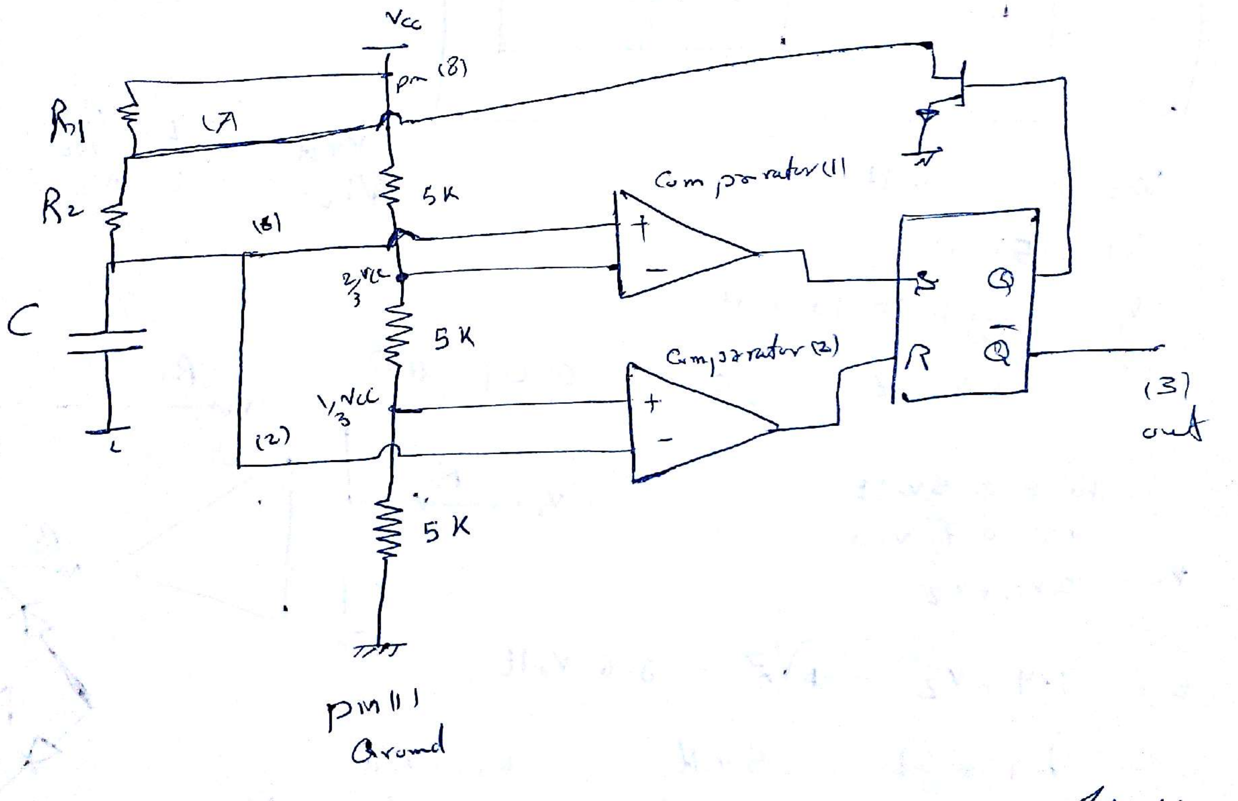
$T = 10^{-3}$ sec

$C = 0.01\ \mu F$

$$\frac{5}{R(0.01\times10^{-6})} = \frac{10}{0.5\times10^{-3}}$$

$$\therefore R = 25K\Omega$$

B) Explain the operation of 555 timer as A stable multi vi berator.

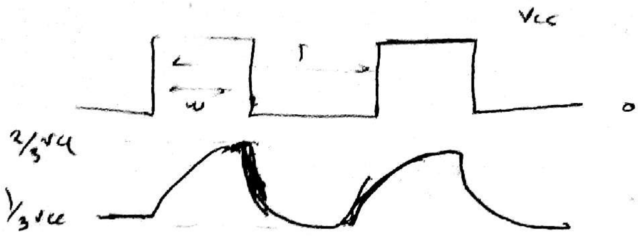


$UTP = \frac{2}{3}V_{cc}$

$LTP = \frac{V_{cc}}{3}$

* عندما يكون Q في حالة (Low) والـ $\bar{Q}$ في حالة High
الـ Transistor في cut-off لذلك يقوم المكثف
بالشحن من خلال المقاومات (R_1+R_2) ويكون زمن الشحن $(R_1+R_2)C$
وعندما يصل المكثف الى قيمة $\frac{2V_{cc}}{3}$ ولذلك يكون S=1 خرج Comparator(1)
الأعلى في حالة الـ High ويكون Q=1 & $\bar{Q}=0$ ويكون الـ Transistor في حالة
الـ Saturation ويقوم المكثف بتفريغ شحنته حتى يصل الى قيمة أقل من $\frac{V_{cc}}{3}$
وعندما يصل إلى هذه القيمة يكون خرج Comparator(2) high ولذلك يكون R=1،
الـ S=0 ولذلك يكون خرج FlipFlop Q=0 , $\bar{Q}=1$ ويقوم المكثف بالشحن

حتى يصل إلى قيمة أكبر من $\frac{2V_{cc}}{3}$ ويتكرر مامرة أخرى



$w_L = 0.693 R_2 C$ $\quad$ $w_H = 0.693 (R_1 + R_2) C$

$T = 0.693 (R_1 + 2R_2) C$

$$f = \frac{1.44}{(R_1 + 2R_2) C}$$

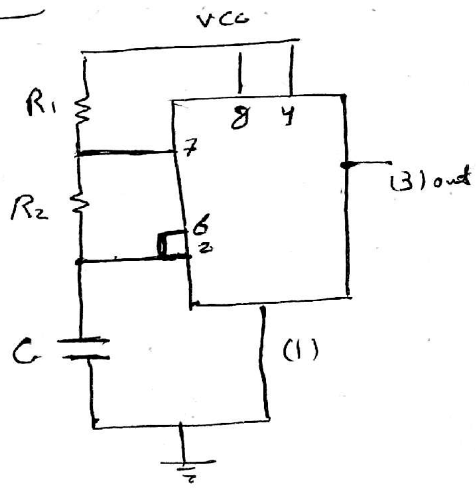
$$D = \frac{R_1 + R_2}{R_1 + 2R_2} = \frac{w}{T}$$

(c) $C = 680 \times 10^{-12}$ F

$f = 50$ KHZ

Duty $= 0.75$

$T = \frac{1}{f} = 20\ \mu sec$



$t_1 = 0.693 (R_1 + R_2) C$

$t_2 = 0.693\ R_2\ C$

$T_1 = 0.75 \times 20\ \mu sec = 15\ \mu sec$

$T_2 = 0.25 \times 20\ \mu sec = 5\ \mu sec$

$5\ \mu sec = 0.693\ R_2\ (680 \times 10^{-12})$

$\therefore R_2 = 10.61\ K\Omega$

$15\ \mu sec = 0.693\ (R_1 + 10.61 \times 10^3)\ 680 \times 10^{-12}$

$R_1 = 21.22\ K\Omega$

Question No. 5:

A) Pulse echo system is one of ultrasonic measurement system..

→ A piezoelectric crystal acting as a transmitter/receiver is attached to medium 1, the characteristic impedence of medium 1 and 2 are substantially different.

When crystal acts as a transmitter an oscillator giving a sinusoidal voltage at radio frequency f connected to the crystal for a time T_W using switch A. Thus a pulse of ultrasound of width T_W enters medium 1 and most of the pulse energy is reflected at boundary of medium 1 with medium 2.

→ The reflected pulse returns to the crystal at a time T_T after the outgoing pulse. since T_T is the time for 'round trip' of distance 2l:

$$T_T = \frac{2l}{c}$$

where l is the distance of interface from crystal and c is velocity of sound in medium 1. The crystal now acts as a receiver and converts the reflected pulse into a voltage pulse. Switch B is now closed so that the pulse passes to the echo signal and 'squared up' using schmitt trigger.

- The outgoing and reflected pulse wave forms. These pulse waveforms pass to a logic circuit which detect the leading edge of outgoing pulse

and that of the first reflected pulse, the resulting output is a pulse signal which '1' state during T_T "Transit time". This is used to control a counter which also receive clock pulses at frequency f from signal generator.

Total count $N = f T_T$. This is transferred to a microcontroller using a parallel digital signal. Computer calculates T_T from N & uses $T_T = \frac{2l}{c}$ with known value of c to find l. The measurement is complicated by the creation multiple reflection or 'echoes'. part of the first reflected pulse is reflected at boundary medium 1 & crystal and reflected again at the boundary of media 1 & ② to give a second reflected pulse.

* The process is repeated many times. the amplitude of the reflected pulses dying away due to attenuation Losses in medium (1) and reflection losses at the boundaries.

→ Some conditions should be obeyed. the pulse signal

a) pulse width T_w should be large compared with period $1/f$ of sound wave, that ensures that there are many cycles, sufficient energy in each pulse.

$T_w > 1/f$

b) Tran sit time $T_T > T_W$ to avoid interference (141)

c) repetition time T_R between successive outgoing pulses should be large compared to transit time

$T_R > T_T$ This ensures that all reflections.

B) Advantages ultrasonic waves.

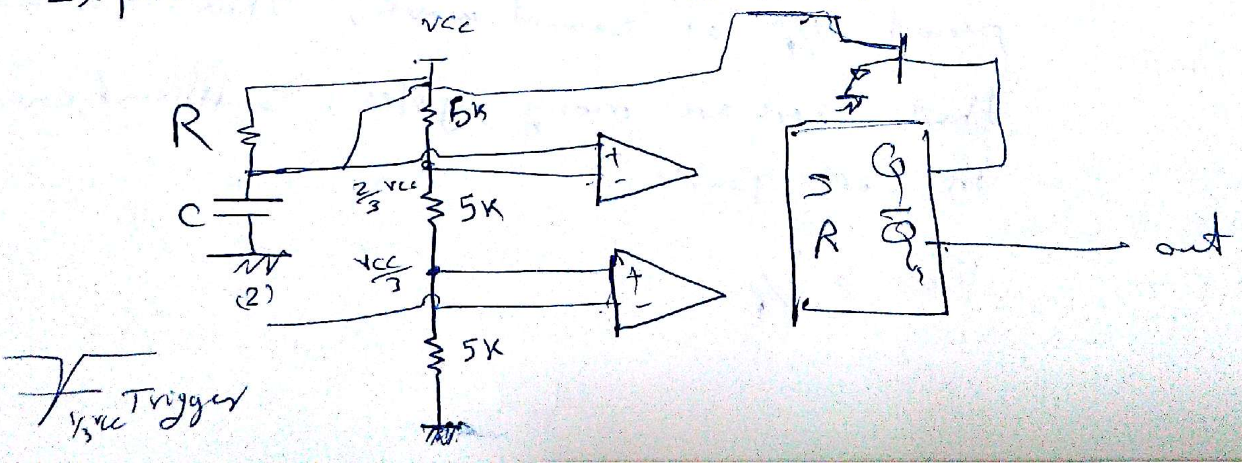
(1) Higer frequency wave have shorter wavelength, This mean that diffraction or bending around an ostcale of given dimension, is correspondingly reduced. It's therefore easier to direct and focus a beam of Ultrasound

(2) ultra sonic waves can pass easily through material of pipes and vessels,

(3) Ultra sound can be launed into and propagated through biological tissue.

(4) The silience of ultra sound means that it has important military application.

c) explain mono stable 555 timer



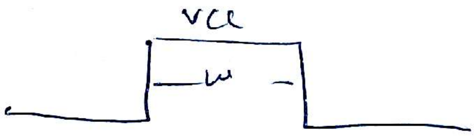
لكي تعمل الدائرة monostable يتم توصيل مقاومة R ومكثف ويتم توصيل لـ Threshold على طرفي المكثف

عمل الدائرة

* نفرض أن $Q=1$ ، $\bar{Q}=0$ لذلك يكون الترانزستور في حالة saturation ولذلك يوصل (SC) ولذلك يكون جهد المكثف = صفر

وعند إدخال trigger على comparator على الطرف السالب ويكون جهد الطرف الموجب $\frac{Vcc}{3}$ وعندما تقل لـ Trigger عن قيمة $\frac{Vcc}{3}$ يكون خرج comparator high ويكون Reset=1 ويكون خرج flip flop $\bar{Q}=1$, $Q=0$ ويكون BJT داخل 555 OFF

لشحنه المكثف حتى يصل إلى $\frac{2Vcc}{3}$ يكون خرج comparator الأعلى high يكون set=1 ويكون خرج flip flop $Q=1$, $\bar{Q}=0$ ويشغل BJT ويفرغ المكثف من خلال المسار BJT



$w = 1.1\,RC$